



WO 2005/056783

PCT/US2004/040844

SEQUENCE LISTING

<110> National Institutes of Health
5 Qasba, Pradman
Boeggeman, Elizabeth
Ramakrishnan, Boopathy

<120> Catalytic Domains Of Beta(1,4)-Galactosyltransferase I Having
10 Altered Metal Ion Specificity

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<170> FastSEQ for Windows Version 4.0

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20<212> PRT
<213> Homo sapiens

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Cys Arg Met Ile Arg His
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30<213> Homo sapiens

<400> 2
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<213> Homo sapiens

5

<400> 4

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His Leu Gly Val Thr Leu Val Tyr Tyr Leu Ala Gly Arg Asp Leu Ser
      35             40             45
Arg Leu Pro Gln Leu Val Gly Val Ser Thr Pro Leu Gln Gly Gly Ser
      50             55             60
15Asn Ser Ala Ala Ala Ile Gly Gln Ser Ser Gly Asp Leu Arg Thr Gly
      65             70             75             80
Gly Ala Arg Pro Pro Pro Pro Leu Gly Ala Ser Ser Gln Pro Arg Pro
      85             90             95
Gly Gly Asp Ser Ser Pro Val Val Asp Ser Gly Pro Gly Pro Ala Ser
20             100             105             110
Asn Leu Thr Ser Val Pro Val Pro His Thr Thr Ala Leu Ser Leu Pro
      115             120             125
Ala Cys Pro Glu Glu Ser Pro Leu Leu Val Gly Pro Met Leu Ile Glu
      130             135             140
25Phe Asn Met Pro Val Asp Leu Glu Leu Val Ala Lys Gln Asn Pro Asn
      145             150             155             160
Val Lys Met Gly Gly Arg Tyr Ala Pro Arg Asp Cys Val Ser Pro His
      165             170             175
Lys Val Ala Ile Ile Ile Pro Phe Arg Asn Arg Gln Glu His Leu Lys
30             180             185             190
Tyr Trp Leu Tyr Tyr Leu His Pro Val Leu Gln Arg Gln Gln Leu Asp
      195             200             205
Tyr Gly Ile Tyr Val Ile Asn Gln Ala Gly Asp Thr Ile Phe Asn Arg
      210             215             220
35Ala Lys Leu Leu Asn Val Gly Phe Gln Glu Ala Leu Lys Asp Tyr Asp
      225             230             235             240
Tyr Thr Cys Phe Val Phe Ser Asp Val Asp Leu Ile Pro Met Asn Asp
      245             250             255
His Asn Ala Tyr Arg Cys Phe Ser Gln Pro Arg His Ile Ser Val Ala
40             260             265             270
Met Asp Lys Phe Gly Phe Ser Leu Pro Tyr Val Gln Tyr Phe Gly Gly
      275             280             285

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3

Val Ser Ala Ser Ser Lys Gln Gln Phe Leu Thr Ile Asn Gly Phe Pro
 290 295 300
 Asn Asn Tyr Trp Gly Trp Gly Gly Glu Asp Asp Asp Ile Phe Asn Arg
 305 310 315 320
 5Leu Val Phe Arg Gly Met Ser Ile Ser Arg Pro Asn Ala Val Val Gly
 325 330 335
 Thr Cys Arg Met Ile Arg His Ser Arg Asp Lys Lys Asn Glu Pro Asn
 340 345 350
 Pro Gln Arg Phe Asp Arg Ile Ala His Thr Lys Glu Thr Met Leu Ser
 10 355 360 365
 Asp Gly Leu Asn Ser Leu Thr Tyr Gln Val Leu Asp Val Gln Arg Tyr
 370 375 380
 Pro Leu Tyr Thr Gln Ile Thr Val Asp Ile Gly Thr Pro Ser
 385 390 395
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 Ala Thr Leu Gln Arg Ala Cys Arg Leu Leu Val Ala Val Cys Ala Leu
 25 20 25 30
 His Leu Gly Val Thr Leu Val Tyr Tyr Leu Ser Gly Arg Asp Leu Ser
 35 40 45
 Arg Leu Pro Gln Leu Val Gly Val Ser Ser Thr Leu Gln Gly Gly Thr
 50 55 60
 30Asn Gly Ala Ala Ala Ser Lys Gln Pro Pro Gly Glu Gln Arg Pro Arg
 65 70 75 80
 Gly Ala Arg Pro Pro Pro Pro Leu Gly Val Ser Pro Lys Pro Arg Pro
 85 90 95
 Gly Leu Asp Ser Ser Pro Gly Ala Ala Ser Gly Pro Gly Leu Lys Ser
 35 100 105 110
 Asn Leu Ser Ser Leu Pro Val Pro Thr Thr Thr Gly Leu Leu Ser Leu
 115 120 125
 Pro Ala Cys Pro Glu Glu Ser Pro Leu Leu Val Gly Pro Met Leu Ile
 130 135 140
 40Asp Phe Asn Ile Ala Val Asp Leu Glu Leu Leu Ala Lys Lys Asn Pro
 145 150 155 160

4

Glu Ile Lys Thr Gly Gly Arg Tyr Ser Pro Lys Asp Cys Val Ser Pro
 165 170 175
 His Lys Val Ala Ile Ile Ile Pro Phe Arg Asn Arg Gln Glu His Leu
 180 185 190
 5Lys Tyr Trp Leu Tyr Tyr Leu His Pro Ile Leu Gln Arg Gln Gln Leu
 195 200 205
 Asp Tyr Gly Ile Tyr Val Ile Asn Gln Ala Gly Asp Thr Met Phe Asn
 210 215 220
 Arg Ala Lys Leu Leu Asn Ile Gly Phe Gln Glu Ala Leu Lys Asp Tyr
 10225 230 235 240
 Asp Tyr Asn Cys Phe Val Phe Ser Asp Val Asp Leu Ile Pro Met Asp
 245 250 255
 Asp Arg Asn Ala Tyr Arg Cys Phe Ser Gln Pro Arg His Ile Ser Val
 260 265 270
 15Ala Met Asp Lys Phe Gly Phe Ser Leu Pro Tyr Val Gln Tyr Phe Gly
 275 280 285
 Gly Val Ser Ala Leu Ser Lys Gln Gln Phe Leu Ala Ile Asn Gly Phe
 290 295 300
 Pro Asn Asn Tyr Trp Gly Trp Gly Gly Glu Asp Asp Asp Ile Phe Asn
 20305 310 315 320
 Arg Leu Val His Lys Gly Met Ser Ile Ser Arg Pro Asn Ala Val Val
 325 330 335
 Gly Arg Cys Arg Met Ile Arg His Ser Arg Asp Lys Lys Asn Glu Pro
 340 345 350
 25Asn Pro Gln Arg Phe Asp Arg Ile Ala His Thr Lys Glu Thr Met Arg
 355 360 365
 Phe Asp Gly Leu Asn Ser Leu Thr Tyr Lys Val Leu Asp Val Gln Arg
 370 375 380
 Tyr Pro Leu Tyr Thr Gln Ile Thr Val Asp Ile Gly Thr Pro Arg
 30385 390 395

<210> 6

<211> 402

<212> PRT

35<213> Bos taurus

<400> 6

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 20 25 30

His Leu Gly Val Thr Leu Val Tyr Tyr Leu Ala Gly Arg Asp Leu Arg
 35 40 45
 Arg Leu Pro Gln Leu Val Gly Val His Pro Pro Leu Gln Gly Ser Ser
 50 55 60
 5His Gly Ala Ala Ala Ile Gly Gln Pro Ser Gly Glu Leu Arg Leu Arg
 65 70 75 80
 Gly Val Ala Pro Pro Pro Pro Leu Gln Asn Ser Ser Lys Pro Arg Ser
 85 90 95
 Arg Ala Pro Ser Asn Leu Asp Ala Tyr Ser His Pro Gly Pro Gly Pro
 10 100 105 110
 Gly Pro Gly Ser Asn Leu Thr Ser Ala Pro Val Pro Ser Thr Thr Thr
 115 120 125
 Arg Ser Leu Thr Ala Cys Pro Glu Glu Ser Pro Leu Leu Val Gly Pro
 130 135 140
 15Met Leu Ile Glu Phe Asn Ile Pro Val Asp Leu Lys Leu Ile Glu Gln
 145 150 155 160
 Gln Asn Pro Lys Val Lys Leu Gly Gly Arg Tyr Thr Pro Met Asp Cys
 165 170 175
 Ile Ser Pro His Lys Val Ala Ile Ile Ile Leu Phe Arg Asn Arg Gln
 20 180 185 190
 Glu His Leu Lys Tyr Trp Leu Tyr Tyr Leu His Pro Met Val Gln Arg
 195 200 205
 Gln Gln Leu Asp Tyr Gly Ile Tyr Val Ile Asn Gln Ala Gly Glu Ser
 210 215 220
 25Met Phe Asn Arg Ala Lys Leu Leu Asn Val Gly Phe Lys Glu Ala Leu
 225 230 235 240
 Lys Asp Tyr Asp Tyr Asn Cys Phe Val Phe Ser Asp Val Asp Leu Ile
 245 250 255
 Pro Met Asn Asp His Asn Thr Tyr Arg Cys Phe Ser Gln Pro Arg His
 30 260 265 270
 Ile Ser Val Ala Met Asp Lys Phe Gly Phe Ser Leu Pro Tyr Val Gln
 275 280 285
 Tyr Phe Gly Gly Val Ser Ala Leu Ser Lys Gln Gln Phe Leu Ser Ile
 290 295 300
 35Asn Gly Phe Pro Asn Asn Tyr Trp Gly Trp Gly Gly Glu Asp Asp Asp
 305 310 315 320
 Ile Tyr Asn Arg Leu Ala Phe Arg Gly Met Ser Val Ser Arg Pro Asn
 325 330 335
 Ala Val Ile Gly Lys Cys Arg Met Ile Arg His Ser Arg Asp Lys Lys
 40 340 345 350
 Asn Glu Pro Asn Pro Gln Arg Phe Asp Arg Ile Ala His Thr Lys Glu
 355 360 365

6

Thr Met Leu Ser Asp Gly Leu Asn Ser Leu Thr Tyr Met Val Leu Glu
 370 375 380
 Val Gln Arg Tyr Pro Leu Tyr Thr Lys Ile Thr Val Asp Ile Gly Thr
 385 390 395 400
 5Pro Ser

<210> 7

<211> 113

10<212> PRT

<213> Homo sapiens

<400> 7

Arg Asp Leu Ser Arg Leu Pro Gln Leu Val Gly Val Ser Thr Pro Leu
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 Gln Gly Gly Ser Asn Ser Ala Ala Ala Ile Gly Gln Ser Ser Gly Asp
 20 25 30
 Leu Arg Thr Gly Gly Ala Arg Pro Pro Pro Leu Gly Ala Ser Ser
 35 40 45
 20Gln Pro Arg Pro Gly Gly Asp Ser Ser Pro Val Val Asp Ser Gly Pro
 50 55 60
 Gly Pro Ala Ser Asn Leu Thr Ser Val Pro Val Pro His Thr Thr Ala
 65 70 75 80
 Leu Ser Leu Pro Ala Cys Pro Glu Glu Ser Pro Leu Leu Val Gly Pro
 25 85 90 95
 Met Leu Ile Glu Phe Asn Met Pro Val Asp Leu Glu Leu Val Ala Lys
 100 105 110
 Gln

30

<210> 8

<211> 85

<212> PRT

<213> Bos taurus

35

<400> 8

Arg Asp Leu Arg Arg Leu Pro Gln Leu Val Gly Val His Pro Pro Leu
 1 5 10 15
 Gln Gly Ser Ser His Gly Ala Ala Ala Ile Gly Gln Pro Ser Gly Glu
 40 20 25 30
 Leu Arg Leu Arg Gly Val Ala Pro Pro Pro Leu Gln Asn Ser Ser
 35 40 45

Lys Pro Arg Ser Arg Ala Pro Ser Asn Leu Asp Ala Tyr Ser His Pro
 50 55 60
 Gly Pro Gly Pro Gly Pro Gly Ser Asn Leu Thr Ser Ala Pro Val Pro
 65 70 75 80
 5Ser Thr Thr Thr Arg
 85

<210> 9

<211> 273

10<212> PRT

<213> Homo sapiens

<400> 9

Ser Leu Pro Ala Cys Pro Glu Glu Ser Pro Leu Leu Val Gly Pro Met
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 Leu Ile Glu Phe Asn Met Pro Val Asp Leu Glu Leu Val Ala Lys Gln
 20 25 30
 Asn Pro Asn Val Lys Met Gly Gly Arg Tyr Ala Pro Arg Asp Cys Val
 35 40 45
 20Ser Pro His Lys Val Ala Ile Ile Ile Pro Phe Arg Asn Arg Gln Glu
 50 55 60
 His Leu Lys Tyr Trp Leu Tyr Tyr Leu His Pro Val Leu Gln Arg Gln
 65 70 75 80
 Gln Leu Asp Tyr Gly Ile Tyr Val Ile Asn Gln Ala Gly Asp Thr Ile
 25 85 90 95
 Phe Asn Arg Ala Lys Leu Leu Asn Val Gly Phe Gln Glu Ala Leu Lys
 100 105 110
 Asp Tyr Asp Tyr Thr Cys Phe Val Phe Ser Asp Val Asp Leu Ile Pro
 115 120 125
 30Met Asn Asp His Asn Ala Tyr Arg Cys Phe Ser Gln Pro Arg His Ile
 130 135 140
 Ser Val Ala Met Asp Lys Phe Gly Phe Ser Leu Pro Tyr Val Gln Tyr
 145 150 155 160
 Phe Gly Gly Val Ser Ala Ser Ser Lys Gln Gln Phe Leu Thr Ile Asn
 35 165 170 175
 Gly Phe Pro Asn Asn Tyr Trp Gly Trp Gly Gly Glu Asp Asp Asp Ile
 180 185 190
 Phe Asn Arg Leu Val Phe Arg Gly Met Ser Ile Ser Arg Pro Asn Ala
 195 200 205
 40Val Val Gly Thr Cys Arg Met Ile Arg His Ser Arg Asp Lys Lys Asn
 210 215 220

8

Glu Pro Asn Pro Gln Arg Phe Asp Arg Ile Ala His Thr Lys Glu Thr
 225 230 235 240
 Met Leu Ser Asp Gly Leu Asn Ser Leu Thr Tyr Gln Val Leu Asp Val
 245 250 255
 5Gln Arg Tyr Pro Leu Tyr Thr Gln Ile Thr Val Asp Ile Gly Thr Pro
 260 265 270
 Ser

10<210> 10
 <211> 273
 <212> PRT
 <213> Bos taurus

15<400> 10

Ser Leu Thr Ala Cys Pro Glu Glu Ser Pro Leu Leu Val Gly Pro Met
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 Leu Ile Glu Phe Asn Ile Pro Val Asp Leu Lys Leu Ile Glu Gln Gln
 20 25 30
 20Asn Pro Lys Val Lys Leu Gly Gly Arg Tyr Thr Pro Met Asp Cys Ile
 35 40 45
 Ser Pro His Lys Val Ala Ile Ile Ile Leu Phe Arg Asn Arg Gln Glu
 50 55 60
 His Leu Lys Tyr Trp Leu Tyr Tyr Leu His Pro Met Val Gln Arg Gln
 2565 70 75 80
 Gln Leu Asp Tyr Gly Ile Tyr Val Ile Asn Gln Ala Gly Glu Ser Met
 85 90 95
 Phe Asn Arg Ala Lys Leu Leu Asn Val Gly Phe Lys Glu Ala Leu Lys
 100 105 110
 30Asp Tyr Asp Tyr Asn Cys Phe Val Phe Ser Asp Val Asp Leu Ile Pro
 115 120 125
 Met Asn Asp His Asn Thr Tyr Arg Cys Phe Ser Gln Pro Arg His Ile
 130 135 140
 Ser Val Ala Met Asp Lys Phe Gly Phe Ser Leu Pro Tyr Val Gln Tyr
 35145 150 155 160
 Phe Gly Gly Val Ser Ala Leu Ser Lys Gln Gln Phe Leu Ser Ile Asn
 165 170 175
 Gly Phe Pro Asn Asn Tyr Trp Gly Trp Gly Gly Glu Asp Asp Asp Ile
 180 185 190
 40Tyr Asn Arg Leu Ala Phe Arg Gly Met Ser Val Ser Arg Pro Asn Ala
 195 200 205

Val Ile Gly Lys Cys Arg Met Ile Arg His Ser Arg Asp Lys Lys Asn
 210 215 220
 Glu Pro Asn Pro Gln Arg Phe Asp Arg Ile Ala His Thr Lys Glu Thr
 225 230 235 240
 5Met Leu Ser Asp Gly Leu Asn Ser Leu Thr Tyr Met Val Leu Glu Val
 245 250 255
 Gln Arg Tyr Pro Leu Tyr Thr Lys Ile Thr Val Asp Ile Gly Thr Pro
 260 265 270
 Ser

10

<210> 11

<211> 1197

<212> PRT

15<213> Homo sapiens

<400> 11

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 Cys Gly Cys Cys Gly Cys Gly Ala Thr Gly Cys Cys Ala Gly Gly Cys
 35 40 45
 Gly Cys Gly Thr Cys Cys Cys Thr Ala Cys Ala Gly Cys Gly Gly Gly
 25 50 55 60
 Cys Cys Thr Gly Cys Cys Gly Cys Cys Thr Gly Cys Thr Cys Gly Thr
 65 70 75 80
 Gly Gly Cys Cys Gly Thr Cys Thr Gly Cys Gly Cys Thr Cys Thr Gly
 85 90 95
 30Cys Ala Cys Cys Thr Thr Gly Gly Cys Gly Thr Cys Ala Cys Cys Cys
 100 105 110
 Thr Cys Gly Thr Thr Thr Ala Cys Thr Ala Cys Cys Thr Gly Gly Cys
 115 120 125
 Thr Gly Gly Cys Cys Gly Cys Gly Ala Cys Cys Thr Gly Ala Gly Cys
 35 130 135 140
 Cys Gly Cys Cys Thr Gly Cys Cys Cys Cys Ala Ala Cys Thr Gly Gly
 145 150 155 160
 Thr Cys Gly Gly Ala Gly Thr Cys Thr Cys Cys Ala Cys Ala Cys Cys
 165 170 175
 40Gly Cys Thr Gly Cys Ala Gly Gly Gly Cys Gly Gly Gly Thr Cys Gly
 180 185 190

10

Ala Ala Cys Ala Gly Thr Gly Cys Cys Gly Cys Cys Gly Cys Cys Ala
 195 200 205
 Thr Cys Gly Gly Gly Cys Ala Gly Thr Cys Cys Thr Cys Cys Gly Gly
 210 215 220
 SGly Gly Ala Cys Cys Thr Cys Cys Gly Gly Ala Cys Cys Gly Gly Ala
 225 230 235 240
 Gly Gly Gly Gly Cys Cys Cys Gly Gly Cys Cys Gly Cys Cys Gly Cys
 245 250 255
 Cys Thr Cys Cys Thr Cys Thr Ala Gly Gly Cys Gly Cys Cys Thr Cys
 10 260 265 270
 Cys Thr Cys Cys Cys Ala Gly Cys Cys Gly Cys Gly Cys Cys Cys Gly
 275 280 285
 Gly Gly Thr Gly Gly Cys Gly Ala Cys Thr Cys Cys Ala Gly Cys Cys
 290 295 300
 15Cys Ala Gly Thr Cys Gly Thr Gly Gly Ala Thr Thr Cys Thr Gly Gly
 305 310 315 320
 Cys Cys Cys Thr Gly Gly Cys Cys Cys Cys Gly Cys Thr Ala Gly Cys
 325 330 335
 Ala Ala Cys Thr Thr Gly Ala Cys Cys Thr Cys Gly Gly Thr Cys Cys
 20 340 345 350
 Cys Ala Gly Thr Gly Cys Cys Cys Cys Ala Cys Ala Cys Cys Ala Cys
 355 360 365
 Cys Gly Cys Ala Cys Thr Gly Thr Cys Gly Cys Thr Gly Cys Cys Cys
 370 375 380
 25Gly Cys Cys Thr Gly Cys Cys Cys Thr Gly Ala Gly Gly Ala Gly Thr
 385 390 395 400
 Cys Cys Cys Cys Gly Cys Thr Gly Cys Thr Thr Gly Thr Gly Gly Gly
 405 410 415
 Cys Cys Cys Cys Ala Thr Gly Cys Thr Gly Ala Thr Thr Gly Ala Gly
 30 420 425 430
 Thr Thr Thr Ala Ala Cys Ala Thr Gly Cys Cys Thr Gly Thr Gly Gly
 435 440 445
 Ala Cys Cys Thr Gly Gly Ala Gly Cys Thr Cys Gly Thr Gly Gly Cys
 450 455 460
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 465 470 475 480
 Gly Thr Gly Ala Ala Gly Ala Thr Gly Gly Gly Cys Gly Gly Cys Cys
 485 490 495
 Gly Cys Thr Ala Thr Gly Cys Cys Cys Cys Cys Ala Gly Gly Gly Ala
 40 500 505 510
 Cys Thr Gly Cys Gly Thr Cys Thr Cys Thr Cys Cys Thr Cys Ala Cys
 515 520 525

Ala Ala Gly Gly Thr Gly Gly Cys Cys Ala Thr Cys Ala Thr Cys Ala
 530 535 540
 Thr Thr Cys Cys Ala Thr Thr Cys Cys Gly Cys Ala Ala Cys Cys Gly
 545 550 555 560
 5Gly Cys Ala Gly Gly Ala Gly Cys Ala Cys Cys Thr Cys Ala Ala Gly
 565 570 575
 Thr Ala Cys Thr Gly Gly Cys Thr Ala Thr Ala Thr Thr Ala Thr Thr
 580 585 590
 Thr Gly Cys Ala Cys Cys Cys Ala Gly Thr Cys Cys Thr Gly Cys Ala
 10 595 600 605
 Gly Cys Gly Cys Cys Ala Gly Cys Ala Gly Cys Thr Gly Gly Ala Cys
 610 615 620
 Thr Ala Thr Gly Gly Cys Ala Thr Cys Thr Ala Thr Gly Thr Thr Ala
 625 630 635 640
 15Thr Cys Ala Ala Cys Cys Ala Gly Gly Cys Gly Gly Gly Ala Gly Ala
 645 650 655
 Cys Ala Cys Thr Ala Thr Ala Thr Thr Cys Ala Ala Thr Cys Gly Thr
 660 665 670
 Gly Cys Thr Ala Ala Gly Cys Thr Cys Cys Thr Cys Ala Ala Thr Gly
 20 675 680 685
 Thr Thr Gly Gly Cys Thr Thr Thr Cys Ala Ala Gly Ala Ala Gly Cys
 690 695 700
 Cys Thr Thr Gly Ala Ala Gly Gly Ala Cys Thr Ala Thr Gly Ala Cys
 705 710 715 720
 25Thr Ala Cys Ala Cys Cys Thr Gly Cys Thr Thr Thr Gly Thr Gly Thr
 725 730 735
 Thr Thr Ala Gly Thr Gly Ala Cys Gly Thr Gly Gly Ala Cys Cys Thr
 740 745 750
 Cys Ala Thr Thr Cys Cys Ala Ala Thr Gly Ala Ala Thr Gly Ala Thr
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 770 775 780
 Gly Thr Thr Thr Thr Thr Cys Ala Cys Ala Gly Cys Cys Ala Cys Gly
 785 790 795 800
 35Gly Cys Ala Cys Ala Thr Thr Thr Cys Cys Gly Thr Thr Gly Cys Ala
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 Ala Thr Gly Gly Ala Thr Ala Ala Gly Thr Thr Thr Gly Gly Ala Thr
 820 825 830
 Thr Cys Ala Gly Cys Cys Thr Ala Cys Cys Thr Thr Ala Thr Gly Thr
 40 835 840 845
 Thr Cys Ala Gly Thr Ala Thr Thr Thr Gly Gly Ala Gly Gly Thr
 850 855 860

12

Gly Thr Cys Thr Cys Thr Gly Cys Thr Thr Cys Ala Ala Gly Thr Ala
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 Ala Ala Cys Ala Ala Cys Ala Gly Thr Thr Thr Cys Thr Ala Ala Cys
 885 890 895
 5Cys Ala Thr Cys Ala Ala Thr Gly Gly Ala Thr Thr Thr Cys Cys Thr
 900 905 910
 Ala Ala Thr Ala Ala Thr Thr Ala Thr Thr Gly Gly Gly Gly Cys Thr
 915 920 925
 Gly Gly Gly Gly Ala Gly Gly Ala Gly Ala Ala Gly Ala Thr Gly Ala
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 Thr Gly Ala Cys Ala Thr Thr Thr Thr Thr Ala Ala Cys Ala Gly Ala
 945 950 955 960
 Thr Thr Ala Gly Thr Thr Thr Thr Thr Ala Gly Ala Gly Gly Cys Ala
 965 970 975
 15Thr Gly Thr Cys Thr Ala Thr Ala Thr Cys Thr Cys Gly Cys Cys Cys
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 Ala Cys Gly Thr Gly Thr Cys Gly Cys Ala Thr Gly Ala Thr Cys Cys
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 1060 1065 1070
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 30 1090 1095 1100
 Gly Ala Thr Gly Gly Thr Thr Thr Gly Ala Ala Cys Thr Cys Ala Cys
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 Thr Cys Ala Cys Cys Thr Ala Cys Cys Ala Gly Gly Thr Gly Cys Thr
 1125 1130 1135
 35Gly Gly Ala Thr Gly Thr Ala Cys Ala Gly Ala Gly Ala Thr Ala Cys
 1140 1145 1150
 Cys Cys Ala Thr Thr Gly Thr Ala Thr Ala Cys Cys Cys Ala Ala Ala
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 40 1170 1175 1180
 Gly Ala Cys Ala Cys Cys Gly Ala Gly Cys Thr Ala Gly
 1185 1190 1195

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<211> 36

<212> DNA

<213> Artificial Sequence

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<220>

<223> A synthetic primer

<400> 12

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36

<210> 13

<211> 36

<212> DNA

15<213> Artificial Sequence

<220>

<223> A synthetic primer

20<400> 13

atcggaaga cgcgtgagat ccgccactcg agagac

36